REMARKS

Two new claims based on the first paragraph on page 6 of the application have been presented for considersation by the Examiner.

Claim 1 has been amended for increased clarity and better antecedent basis about what is sintered.

For increased clarity, an amendment has been made to claims in order to state that they are flat and have a sheet-shape. See, e.g., page 9. That description is not indefinite when the claims is viewed, as required, as they would be understood by a person skilled in this art. What is flat and sheet-shaped are the ceramic crystal grains and not bed linen (and rolled up bed linen would not be described as "sheet-shaped"). The skilled person would clearly understand that the ceramic crystal grains have major surfaces which are essentially parallel and distinctly greater than minor surfaces (e.g., side surfaces).

Withdrawal of the rejection under 35 USC § 112 is respectfully requested.

All claims have been rejected under 35 U.S.C. § 103 over Hirao in view of Kingery, Panda, Goldberger, Korb, Kawai and Adachi. This rejection is respectfully traversed.

Conventionally, a ceramic laminate is produced by laminating ceramic green sheets, press bonding the sheets to one another and firing the resulting stack. In such a method, the pressing is such that the area of the respective grain sheets in the direction of perpendicular to the pressing axis are prevented from increasing and the crystal grains of the ceramic are not oriented. As shown in the table on page 3, pressing under these conditions does not increase orientation. While alternative methods which produce oriented ceramics are known, those methods are generally expensive and

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unsuited for mass production. The present Applicants discovered that an oriented product could be produced by the process which is that set forth in the claims of the present application.

The Hirao patent discloses a method in which a silicon nitride raw material powder and beta-silicon nitride single crystals in rod-like form are combined, formed into a slurry which is converted into sheets, stacked under pressure and then sintered. There is no teaching or suggestion that the orientation degree can be changed, as in the present invention. That change is a necessary consequence of the claimed method. As the Examiner has acknowledged, Hirao does not teach or suggest use of a metal mold.

In an attempt to overcome this deficiency, the rejection first relies on Kingery but it is respectfully submitted that such reliance is misplaced for at least three reasons. First, the sentence on page 10 previously referenced by the Examiner refers to compaction of a "powder" and not a flat, sheet product using a metal die. Secondly, the same paragraph teaches away from use of a metal mold in that it says use of a metal mold leads to pressure gradients and a resulting variation of density, which during sintering leads to a variation in shrinkage and a loss of tolerances, and recommends use of a rubber mold. That the Examiner may doubt that many patents would be granted "merely" because they recite "metal" is not relevant in the abstract and saying the reference shows a metal mold improperly fails to consider what it says about the mold material. Third, the claims here call for the sheet product to be spaced apart from a sidewall of the metallic mold but the mere reference to a metal mold does not even hint about any such positioning. To the contrary, Kingery indicates a problem arises because of the forces of the powder against the die wall, which indicates the powder is not spaced apart from the sidewall. See Kingery page 10, second paragraph, lines 13-18.

It is not possible to manipulate the combined teachings of Hirao and Kingery, even using impermissible hindsight, and realize the claimed invention. Any such combination must be further changed and there is nothing in the art to suggest how or to motivation the skilled person to make the necessary changes.

As a result of the incorporation of prior rejections by reference, the Office Action asserts that Hirai's pressing to a particular thickness inherently increases the area. It is respectfully submitted this assertion is not valid because any assertion of inherency can only be based where there is certainty, i.e., there is one and only one possibility. Proposed reasonable inferences about what the skilled person might draw are not enough. *In re Robertson*, 49 USPQ2d 1949, 1919 (Fed. Cir. 1999)("inherency is not established by probabilities or possibilities"). Certainty is absent here for several reasons. First, while material must move "somewhere", the assertion presupposes, without factual basis, that the "somewhere" is such that the area must expand. But the mold has a fixed area and Kingery teaches the powder abuts the sidewalls of the mold. Pressing will not change the mold's fixed area. Secondly, it is respectfully pointed out that heat and pressing can serve to drive off air in the sheets or trapped between sheets or drive off the binder in the sheets, as Hirao teaches at col. 4, lines 59-60. The scientific law "Conservation of Mass" is not to the contrary since binder and air are being removed from the system creating voids into which the powder can move. Those voids constitute the "somewhere", preserving the powder's mass but reducing the volume occupied by the mass. Hirao's actions may densify the sheets by reducing their thickness, but that does not necessarily mean that "the area of a plane perpendicular to the pressing axis of the product is increased compared to that before the pressing", as recited in claim 1 of this application. Nothing in Hirao suggests increasing the area of that plane.

The Office Action also proposes, as a result of the incorporation by reference, an alternative basis which is that Kingery teaches pressure is a result effective variable and it would be obvious to optimize it. While Kingery may teach pressure effects the density of the compact, and it might be obvious to vary the pressure to optimize density, that still does not suggest the perpendicular area (as opposed to the thickness) will change depending on the pressure.

The newly cited Panda reference indicates that a powder of silicon carbide (not nitride) ceramics and other ceramics can be forged in an open or closed die and in some instances, it is preferable that the die be open. The reference, however, is not dealing with a sheet-form slurry. The Office Action does not attempt to show that whatever Panda may say about the advantages/disadvantages of a metal mold/die relative to graphite in the context of forging a powder is pertinent to sheet-form slurries. The reference also fails to teach or suggest that there may be any orientation change, as in the present invention.

Goldberger shows an open die exists for use in connection with nitrides and carbides but as the Examiner has pointed out, uses graphite. At best, this reference shows open dies exist. It does not teach or suggest that dies or molds effect orientation change, as in the present invention.

Korb has been cited to show pressing material in contact with sidewalls can cause problems but that teaching concerns the lifting of flat, close tolerance, thermosetting, graphic resin plates used as precursor for carbonization to vitreous carbon plates usable as separator plates and batteries from a mold. It is not concerned with ceramic sheet-form products and does not teach or suggest anything about orientation degree.

Kawai relates to the manufacture of a gas discharge type display panel in which a glass paste and glass green sheets are manipulated. In order to avoid the problems encountered when forming barrier ribs by a stamping process (see column 1), the patent resorts to a rolling process in which, as shown in the drawings, the glass paste is placed on a flat surface. As a roller moves across the surface of the paste, the portion of the paste in front of the roller is raised by means of the peripheral surface of the roller to form blanks. As a consequence of this procedure, an oriented formed product as in the present invention is not realized. The barrier rib blanks may be oriented in the direction that the sheet moves but they will not be oriented sufficiently in the perpendicular direction to the movement. Further, the barrier rib blanks realized do not have a reduced thickness but, quite to the contrary, have an increased thickness as can be seen in the drawings. It is respectfully submitted that this reference is not pertinent to the claimed invention.

The Adachi reference relates to a method of fabricating a ceramic multi-layer substrate in which a plurality of grain sheets are laminated, sandwiched between restricting green layers, pressed and fired. In an example, there was a thickness reduction. However, like the primary reference, Adachi does not relate to increasing the orientation degree, which is a consequence of the claimed method. Further, this reference does not disclose that the area in the plane perpendicular to the pressing axis of the green sheet is increased compared to that before pressing.

The process of the present invention compared to the prior art is shown in Figures 1 and 2 of this application. In Figure 1, the stacked laminate is placed in the mold and the relative size of the mold cavity and the stack are such that the area perpendicular to the pressing direction can be increased. In the TGG method of Figure 2, the stack and size of the cavity are such that no increase in area is possible. Tables 3 and 4 and the graph of Figure 3 of the application show that the orientation degree of

the samples in accordance with the invention was higher than those of the samples obtained by the TGG method. As apparent from Table 3, the electromechanical coupling coefficient (%) at thickness shear mode vibration increases with an increase in the orientation degree. This result is clearly new, as evidenced by the lack of any reference disclosing this result. Nothing in the prior art teaches or suggests that the new result achieved by the present invention was possible. Increasing orientation degree to some extent may be possible by other methods but nothing in the art suggests the claimed method can achieve this result. The claimed method, acknowledged to be new and different from the prior art, achieved results which are both surprising and unexpected.

None of the references, whether considered alone or in combination, suggest that pressing a sheet product formed from a ceramic slurry containing a powder of ceramic crystal grains having a shape anisotropy mixed with a ceramic raw material powder or a calcined ceramic raw material powder, or both, such that the length of the product in the direction parallel to the pressing axis is decreased and the area of the claim perpendicular to the pressing axis of the product is increased compared to those dimensions before the pressing will cause an oriented form product to be produced. The fact that such a result is achieved, as shown in the present invention, is surprising and unexpected and therefore unobvious.

Beyond the foregoing, claims 4, 5, 6 and 8 recited that the ceramic crystal grains having a shape-anisotropy are flat and have a sheet-shape with an aspect ratio of about 4 to 10. No teaching or suggestion of that aspect ratio has been noted in the references. Rods, by definition, are cylindrical, and no matter how long they may be, they are not flat and sheet-shaped. The prior observation, incorporated in the rejection by reference, that the rods may be "lying flat" concerns how the rods are positioned

rather whether that their shape is flat; these claims require the ceramic to be flat and sheet-shaped.

It is respectfully submitted that the rejection is predicated on selecting bits and pieces, out of context, from seven difference references without any motivation to do so. That is the essence of a hindsight reconstruction, which, of course, is not permissible.

In light of the foregoing considerations, it is respectfully submitted that this application is now in condition to be allowed and the early issuance of a Notice of Allowance is respectfully solicited.

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Respectfully submitted,

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